DEVELOPMENT OF ELECTRONIC EDGE FINDER

NORAINI BINTI MAT DAUD

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ABSTRACT

EDGE FINDER is a tool used to accurately determine edges or markings and therefore the center of a workpiece or a previously machined feature during the set-up phase of a machining operation. The electronic circuit has been designed to develop the Electronic Edge Finder. The electronic circuits contains of two magnetic wire probes when connected between the vise and the spindle of the milling machine. The Electronic Edge Finder is connected directly to the tool and spindle on the milling without any modification to the machine. It is detect the changes of the electrical resistance of the machine when there are contact between the workpiece and the tool. It is then to use to setting up the workpiece zero point by referring to the light of the LED on the Electronic Edge Finder circuit. At the end of the project, the Electronic Edge Finder is developed and can be used to setup the tool and marked the zero point on the workpiece.

ABSTRAK

“EDGE FINDER” adalah alatan yang digunakan untuk menentukan bucu atau menandakan origin pada bahan kerja. Proses ini akan dilakukan semasa fasa persediaan sebelum menjalankan sebarang aktiviti yang melibatkan mesin. Litar elektronik telah dicipta untuk menghasilkan “ELECTRONIC EDGE FINDER”. Litar elektronik ini mengandungi dua set wayar magnet yang menghubungkan gelendong dan ragum pada mesin. Wayar magnet ini dihubungkan secara terus tanpa perlu ada pengubahsuaian pada mesin. Litarini akan mengesan perubahan rintangan elektrik apabila alat pada gelendong mesin bergerak menghampiri bahan kerja pada ragum. Litar ini digunakan untuk menentukan origin padabahan kerja berdasarkan nyalaan LED pada litar elektronik. Akhirnya, “ELECTRONIC EDGE FINDER” dihasilkan dan digunakan untuk menandakan titik origin pada bahan kerja.

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EEF	Electronic Edge Finder
DTI	Dial Test Indicator

CHAPTER 1

INTRODUCTION

1.1 OBJECTIVES

Edge finder is an important tool that used in machining process to ensure the center and the zero point of the workpiece. The operation is done before continue to the process of machining. In order to complete the project, there are few objectives that should be constructing. The objectives of this study are:

i. To design the electronic edge finder.
ii. To develop the edge finder.

1.2 PROJECT BACKGROUND

This project is all about the development of an Electronic Edge Finder. Edge finder is a tool used in the spindle of a machine such as a milling. The device is used to accurately determine edges or markings and therefore the center of a workpiece or a previously machined feature during the set-up phase of a machining operation.

In this project, the electronic edge finder is connected directly to the tool and spindle on the milling without any modification to the machine. The edge finder can detect when the tool comes in contact with the workpiece. It is detect the changes of the electrical resistance of the machine. It is detecting the differences between the low electrical resistance between all parts of the milling and the extremely low resistance at the point where the tools first contacts the workpiece. It will be known by alarm in terms of lighting and buzzing.

At the end of the project, the Electronic Edge Finder can be used to set the zero point and to mark the center of the workpiece base on the light of the LED that place in the electronic circuit.

1.3 PROJECT SCOPE

This project is about the development of electronic edge finder. The method that used to achieve the objective is by using electrical circuit that contains two probes. These two probes are connected to the tool and the workpiece respectively. In order to complete this project, precise scope of work and plan should be followed to achieve the objective. The scopes of study are:

1. Study on the application of the edge finder on milling.
2. Study the method of zero setting using edge finder.
3. Research on the development of the edge finder.
4. Design an edge finder for zero setting.

1.4 PROBLEMS STATEMENTS

Zero point setting is an important process in machining. The method that can be used for setting the zero margins on the workpiece can be done by using mechanical edge finder or electronic edge finder. In this project all about the electronic edge finder.

In order to machine metal, wood or plastic accurately in a manual mill, it is essential to accurately set zero point. The electronic edge finder can be used without changing the tool at the machine compared to other conventional method. These devices are easy to used for the machinist. On the other hands, by using this electronic edge finder, it will reduce the time needed to complete a process of machining. It is because, the machinist no need to change the tool. The zero point setting can be proceeding by using any tool either for the previous or next process.

CHAPTER 2

LITERATURE REVIEW

2.1 EDGE FINDER

Edge finder is a tool used in the spindle of a machine such as a milling (Fig 2.1). The device is used to accurately determine edges or markings and therefore the center of a workpiece or a previously machined feature during the set-up phase of a machining operation. A rotating tool, meaning the machine spindle must be turning for the tool to work.

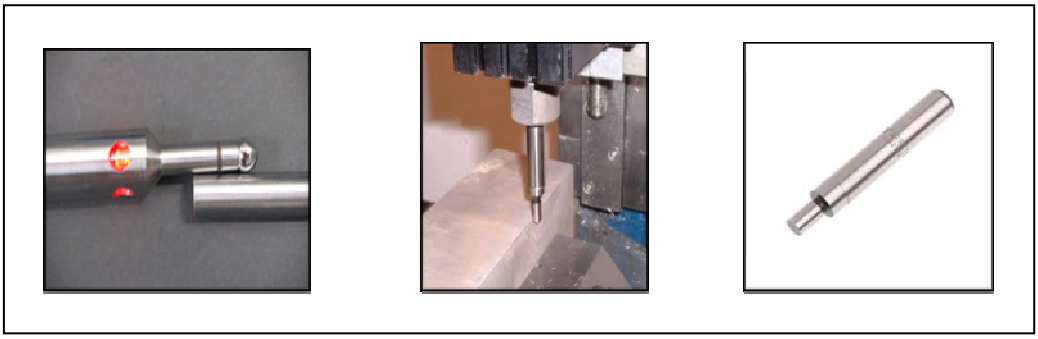

Figure 2.1: Edge Finder

2.2 TOOL FOR ZERO POINT SETTING

Zero point setting on the workpiece can be done by using various method and tools. The methods are by using the Mechanical Edge Finder, Optical Edge Finder, Bump Method, Wiggler, Light-Cut Method, Dial Test Indicator (DTI), and also by Using Laser Edge Finder.

2.2.1 MECHANICAL EDGE FINDER

These methods are usually used to set zero point on the workpiece. The tools that used in this process are a spring loaded conical disc (Fig. 2.2). This disk has to spin to complete this operation. This mechanical edge finder utilizes a spring loaded conical disc that spins while free of the workpiece and then suddenly kicks or slips sideways when contact with the edge of the workpiece is obtained. The disc of this type of edge finder only slips a certain amount and the goes no further. As a result, the machinist can back up and try again without having to reset the contact by hand. Once the edge is found, the machinist moves the workpiece, generally by moving the mill table, over one-half the diameter of the edge finder to align the spindle axis with the plane of the workpiece edge. Some of these types of edge finder include a conically-shaped center finder having a pointed end that is utilized in the same manner as spring loaded conical disc [2].

Figure 2.2: Mechanical Edge Finder

2.2.1.1 The Process of Zero Point Setting By Using Mechanical Edge Finder.

The mechanical edge finder can be used for zero point setting. The edge finder is located in the collets on the spindle milling machine. The spindle is turned ON and the side finders are move slowly toward the workpiece. When the two pieces are exactly straight (Fig 2.3), tool are moved further and the tools are not straight line (Fig 2.4). The points are set as zero [3].

Figure 2.3: Edge finder inline

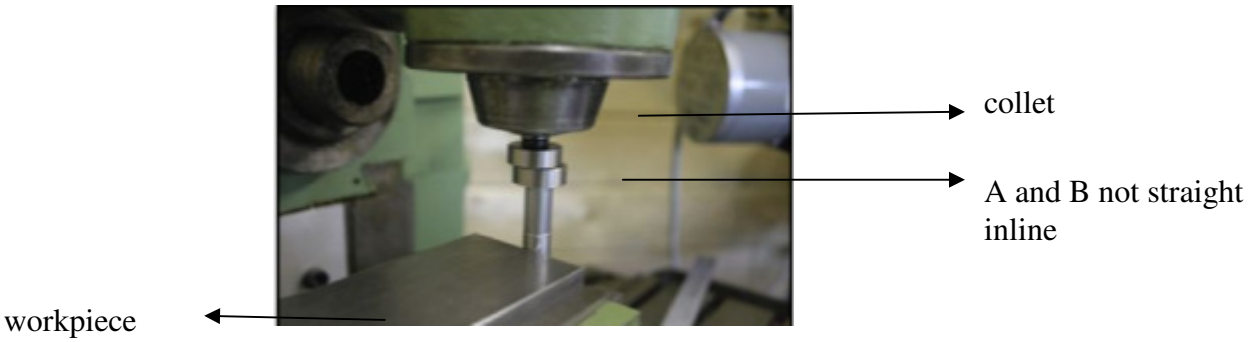

Figure 2.4: Edge Finder not inline

2.2.2 OPTICAL EDGE FINDER

The optical edge finder (Fig. 2.5) is advancement of Mechanical Edge Finder. There are few advantages that come with this device. The benefit is, by using this methods, it will save time to find positions, for milling machine, jig borers and other machine tools. The scope of application includes edge surface, inside and outside diameters and high efficiency. There is a safety spring puller, which will put a ball precisely back to the position when ball breaks away from ball seat [3].

Figure 2.5: Optical Edge Finder

2.2.2.1 The Process Of Zero Point Setting Using Optical Edge Finder

The optical edge finders are mounted into the spindle and its concentricity are checked (Fig. 2.6). The worktables of milling machine are moved to make the edges of workpiece touch the ball off the edge finder until the red lamp is alarm (Fig. 2.7). The dial reading of the table movement are marked, the table are moved backward a little. The edge finder is slightly re-touching the edge finder until the red lamps are alarmed once again. It is to make sure and to get the correct reading (Fig. 2.8). The reading of the dial is marked as zero and the tables are moved to the desired position (Fig. 2.9). The edge finders are taken off and remount the desired tooling for machining (Fig. 2.10).

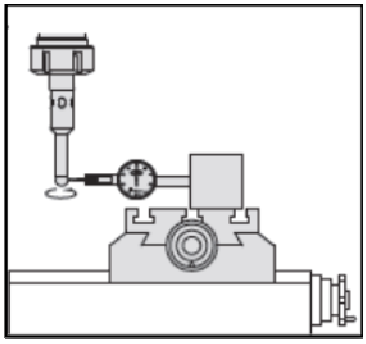

Figure 2.6: Concentricity checked

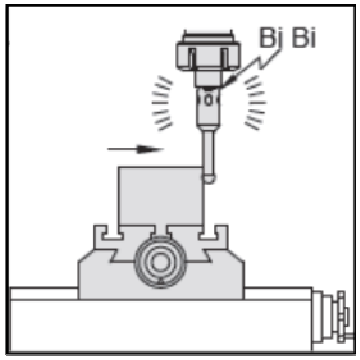

Figure 2.7: The red lamp is alarm

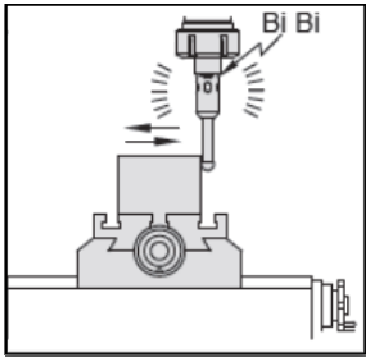

Figure 2.8: Re-touch edge finder to get correct reading

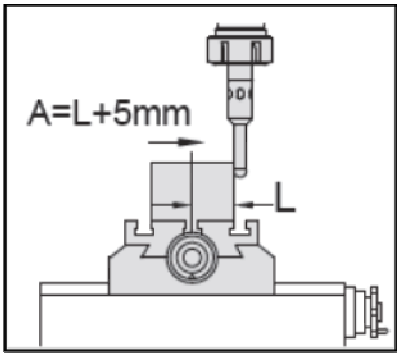

Figure 2.9: Tables are moved to the desired position

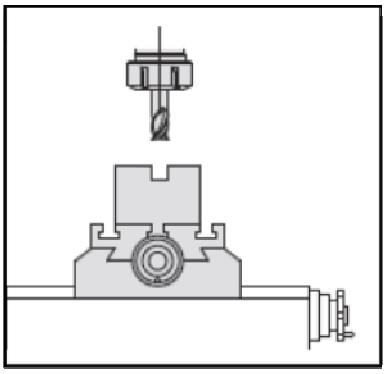

Figure 2.10: Remount the desired tooling for machining

2.2.3 BUMP METHOD

This Bumb Method is mostly practices by the machinists to set zero point on the workpiece. It is about to locate the center or edge of a workpiece relative to a milling machine or other machine tool indirectly locate the reference mark. A common method is to find an edge of a workpiece is generally referred to as a contact or bump method. In this method, a simple piece of round stock is placed in the mill spindle and the work tool is hand cranked to gently but the edge of the workpiece against the round stock. To align the work machine with the edge of the workpiece, the machinist then raises the round stock above the workpiece and moves the workpiece over half the diameter of the round stock. The micrometer dial setting at this position is zeroed to correspond to the edge of the workpiece, thereby aligning the work tool (i.e., the spindle centerline) with the plane running through the edge of the workpiece [3]

Although the contact or bump method is quick and simple, it is well known that it is generally not that accurate due to the inherent problems associated with trying to recognize when the contact occurs and the elasticity of the materials involved. In addition, to the inherent accuracy problems, it is not that uncommon for machinists, particularly relatively inexperienced or hurried machinists, to forget to take into account the one-half of the diameter of the round stock used as the edge finder. Another problem known to be associated with this method of edge finding is that too much contact against the workpiece, which for certain metals is not that much contact, can dent or otherwise damage the workpiece [3].

2.2.4 WIGGLER

Another method for finding the edge of a workpiece utilizes a tool commonly known as a wiggler, which has been used by machinist for over a century. Most wiggler sets come with an edge finder component that has a generally mushroom-shaped disk contact at the end of the wiggle shank opposite that which fits into the collet, typically in a ball and socket type of arrangement. As with the contact method described above, the workpiece is moved towards the spinning edge finder until it gently touches the disk contact and steadies the wiggling. The workpiece is then slowly dialed further towards the edge finder until it is spinning true (i.e., no wiggle). At the point the edge finder starts to slip sideways from the drag of the spinning disk against the workpiece, the machinist has found the edge of the workpiece. As with the contact method, the machinist then raises the edge finder and dials in half of its diameter, typically 0.100 inches, to align the spindle centerline with the edge plane of the workpiece. Although the wiggler edge finder is generally considered to be very accurate for routine machine work and good enough for most high precision work, it is known to be frustrating to utilize due to the fact that it has to be reset for each edge contact [3].

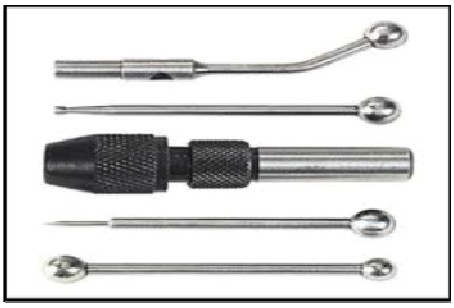

Figure 2.11: Set of Wiggle

2.2.5 DIAL TEST INDICATOR (DTI)

The dial test indicators (Fig. 2.12) are used to set zero point on mills. By using dial test indicator, it will inform when the workpiece are precisely touched down on a surface. On the other hands, dial test indicator (DTI) are also used to measure runout. The dial test indicators are applicable to set zero point for the cylindrical workpiece. It will bring up to the side of a cylinder that can rotate; the dial test indicator is then zeroed. As the cylindrical is turned, the reading of maximum positive and maximum negative is detected [4].

The dial test indicators are actually measures angular displacement and not linear displacement. As the finger of dial test indicator are moves, its pivots around a central point. This rotation is geared to the pointer [4].

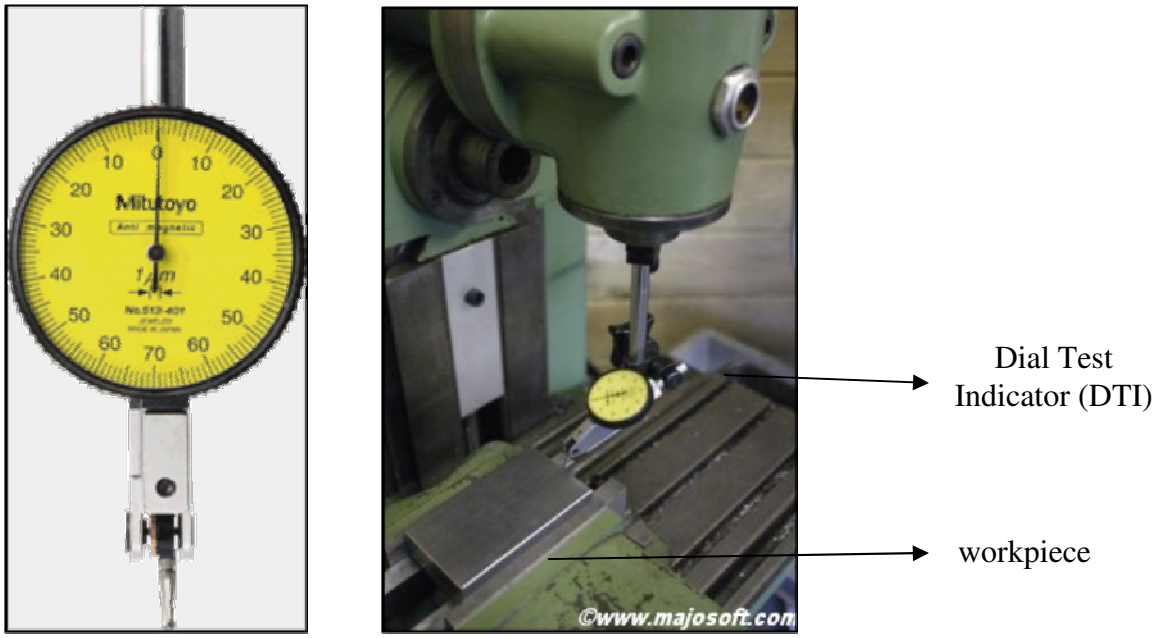

Figure 2.12: Dial Test Indicator

2.2.6 LIGHT- CUT METHOD

Light cut is one of the method that can be use to establish a point on the X or Y axis as zero. The most accurate that has been used is to make a light cut on the part stop with the end mill and set 0 (refer Fig. 2.13). This is the key idea in soft jaws. It is fine as long as all cuts are on that side of the end mill. If switch to the other side, error can creep in if don't know the exact diameter of the end mill. It is also not always practical to cut the stop. The width of that slot is exactly how wide that end mill will cut when mounted in this collet and spindle when cutting aluminum to this depth. Beyond these caveats, long cuts can suffer from variations in the ways. All that is left is to accurately measure this slot. Not all that easy to do with a caliper since the bottom of the slot is not perfectly square and the slot is rather shallow [5].

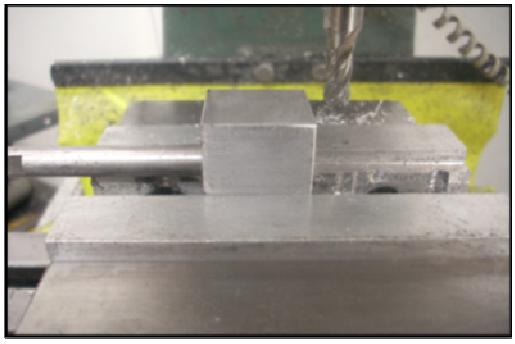

Figure 2.13: Light Cut Method

2.2.7 LASER EDGE FINDER

The laser edge finder (Fig. 2.14) is a new applications in a various situations in the metals, wood and plastic industries. In all cases the simplicity of visual operations and accuracy allow machine operators to quickly establish location points, edges, centers of materials, centers of hole, scribes lines, alignment of vises on mill table, centering of rotary tables and spin indexers. The laser edge finder can also be placed in lathe tailstock after off-set for taper cutting and to set lathe tool bit height. The unit also can be used to visually set the mill head angle [6].

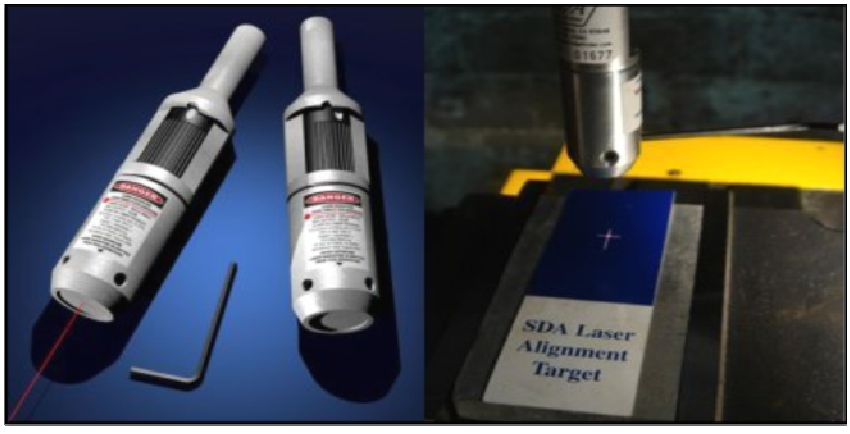

Figure 2.14: Laser Edge Finder

2.3 MILLING MACHINE

A milling machine is a machine tools used to machine solid workpiece. Milling is the process of machining flat, curved, or irregular surfaces by feeding the workpiece against a rotating cutter containing a number of cutting edges. Milling machine removes metal with a revolving cutting tool called a milling cutter. By using milling machine, it can perform a vast number of operations, from simple operation to the complex operation. With various attachments, by using milling machines for boring, slotting, circular milling, dividing, and drilling; cutting keyways, racks, and gears; and fluting taps and reamers [7].

There are classed into two basics forms which are horizontals and verticals (Fig. 2.15). All this refers to the orientation of the main spindle. Milling machine have to move the workpiece radially against the rotating milling cutter to cuts on its side. Milling machines are basically classified as being horizontal or vertical to indicate the axis of the milling machine spindle. These machines are also classified as knee-type, ram-type, manufacturing or bed type, and planer-type milling machines [7].

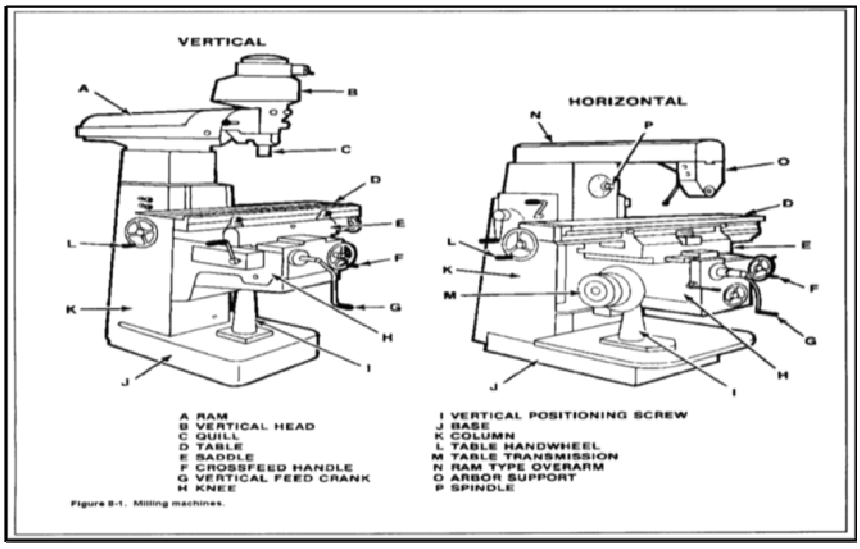

Figure 2.15: Vertical and Horizontal Milling Machine

2.3.1 TYPES OF MILLING MACHINE

Milling machine has a various type of machine. In this chapter, there are two type of machine that will be discussed. There are the knee-type milling machine and ram-type milling machine.

2.3.1.1 KNEE-TYPE MILLING MACHINE

This type of machine is a one of the vertical milling machine. It is because this machine can be adjusted by its worktable. Knee-type milling machines are characterized by a vertical adjustable worktable resting on a saddle supported by a knee [8]. The spindle can be adjusted by vertical movement, and the table can be moved vertically, longitudinally, and transversely. We can control the movement of both the spindle and the table manually or by power. The knee is a massive casting that rides vertically on the milling machine column and can be clamped rigidly to the column in a position where the milling head and the milling machine spindle are properly adjusted vertically for operation [8].

a. Floor-mounted Plain Horizontal Milling Machine

i. It is contains the drive motor and, gearing and a fixed-position horizontal milling machine spindle. An adjustable overhead arm, containing one or more arbor supports projects forward from the top of the column [8]. The arbor can be adjusted at the desire position. The arm and arbor supports are used to stabilize long arbors, upon which the milling cutters are fixed. This support will depend on the location of the milling cutter or cutters on the arbor [8].

ii. A heavy, vertical positioned screw beneath the knee is used for raising and lowering. The saddle rests upon the knee and supports the worktable. The saddle moves in and out on a dovetail to control the cross feed of the worktable.